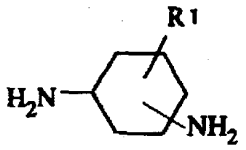
CLAIMS

We claim:

1. A curable epoxy resin composition, which comprises (a) a polyepoxide having two or more oxirane rings per molecule, which is optionally mixed with a monoepoxide having one oxirane ring per molecule; and (b) a ketimine as a curing agent which is a condensation reaction product of (1) an amine having two or more primary amino groups directly bonded to a cyclohexane ring and represented by the following general formulae



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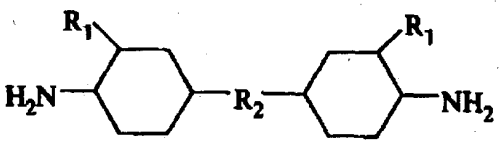
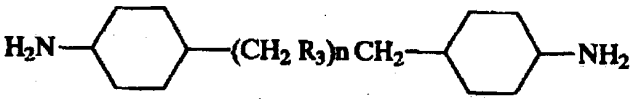
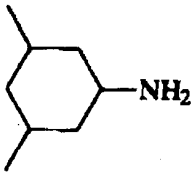


wherein R_1 is a hydrogen atom or a methyl group or an ethyl group, R_2 is a group of -CH_2-, -O- or -SO_2- or



wherein R_3 is



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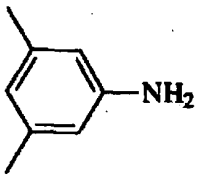


and n is an integer of 1-4 and (2) an aliphatic ketone.

2. The curable epoxy resin composition of claim 1 wherein the ketimine is a condensation reaction product of an aliphatic ketone with 1,2-diaminocyclohexane, 1,3-diaminocyclohexane, 1,4-diaminocyclohexane, 1,2-diamino-4-methylcyclohexane, 1,3-diamino-5-methylcyclohexane, 1,4-diamino-2-methylcyclohexane, 1,2-diamino-4-ethylcyclohexane, 1,3-diamino-5-ethylcyclohexane, 1,4-diamino-2-ethylcyclohexane, bis(4-aminocyclohexyl)methane, bis(4-aminocyclohexyl)ether, bis(4-aminocyclohexyl)-sulfone, bis(3-methyl-4-aminocyclohexyl)methane, bis(3-ethyl-4-aminocyclohexyl)-methane, bis(3-methyl-4-aminocyclohexyl)ether, bis(3-ethyl-4-aminocyclohexyl)ether, bis(3-methyl-4-aminocyclohexyl)sulfone, bis(3-ethyl-4-aminocyclohexyl)sulfone, or an amine obtained by hydrogenation of an oligocondensate of aniline with formaldehyde.

3. The curable epoxy resin composition of claim 1 wherein the ketimine is a condensation reaction product of an aliphatic ketone with an amine having two or more primary amino groups directly bonded to a cyclohexane ring, the aliphatic ketone being 2-propanone, 2-butanone, 3-methyl-2-butanone, 3,3-dimethyl-2-butanone, 2-pentanone, 3-pentanone, 2-methyl-3-pentanone, 3-methyl-2-pentanone, 4-methyl-2-pentanone, 4-methyl-3-pentanone, 2,4-dimethyl-3-pentanone, 2-hexanone, 3-hexanone, 5-methyl-2-hexanone, 2-heptanone, 3-heptanone, 4-heptanone, 2-octanone or 3-octanone.

4. The curable epoxy resin composition of claim 1 wherein the ketimine is a condensation reaction product of an aliphatic ketone with 1,2-diaminocyclohexane, 1,3-diaminocyclohexane, 1,4-diaminocyclohexane, bis(4-aminocyclohexyl)methane, bis(3-methyl-4-aminocyclohexyl)methane or a polyamine obtained by hydrogenation of an oligocondensate of aniline with formaldehyde.

5. The curable epoxy resin composition of claim 1 wherein the ketimine is a condensation reaction product of an aliphatic ketone with an amine having two or more primary amino groups directly bonded to a cyclohexane ring, the aliphatic ketone being 2-butanone, 3,3-dimethyl-2-butanone, 2-pentanone, 3-pentanone, 2-methyl-3-pentanone, 2,4-dimethyl-3-pentanone or 5-methyl-2-hexanone.

6. The curable epoxy resin composition of claim 1 wherein the ketimine is a condensation reaction product of 4-methyl-2-pentanone with an amine having two or more primary amino groups directly bonded to a cyclohexane ring.

7. The curable epoxy resin composition claim 1 wherein the polyepoxide is a polyepoxide of glycidyl ether, glycidyl ether ester, glycidyl ester, glycidyl amine, glycidylaminoglycidyl ether, glycidylaminoglycidyl ester or epoxidized polyolefin type.

8. The curable epoxy resin composition of claim 1 wherein the polyepoxide is a glycidyl ether obtained by reacting a bisphenol-type compound with epichlorohydrin, the bisphenol-type compound being bisphenol A, bisphenol F, bisphenol S, tetrabromobisphenol A, bisphenol hexafluoroacetone, tetramethylbisphenol A, tetramethylbisphenol F, tetrahydrobisphenol F, hexahydrobisphenol A, hydrogenated bisphenol A or hydrogenated bisphenol F with epichlorohydrin;

a glycidyl ether obtained by reacting a novolak-type compound of phenol novolak, cresol novolak, ethylphenol novolak, propylphenol novolak, butylphenol novolak, pentylphenol novolak, octylphenol novolak or nonylphenol novolak with epichlorohydrin;

a glycidyl ether obtained by reacting a polyhydric phenol of catechol, resorsine, trihydroxybiphenyl, dihydroxybenzophenone, bisresorsinol, hydroquinone, tris(hydroxyphenyl)methane, tetrakis(hydroxyphenyl)ethane or bixylenol with epichlorohydrin; or

a polyglycidyl ether obtained by reacting an aliphatic polyhydric alcohol of glycerol, neopentyl alcohol, ethylene glycol, propylene glycol, tetramethylene glycol, hexylene glycol, polyethylene glycol or polypropylene glycol with epichlorohydrin.

9. The curable epoxy resin composition of claim 7 wherein the polyepoxide of glycidyl ether type is a polyglycidyl ether obtained by reacting a polyhydric hydroxy compound of bisphenol A, bisphenol F, phenol novolak, cresol novolak, octylphenol novolak or nonylphenyl novolak with epichlorohydrin; or a polyglycidyl ether obtained by reacting an aliphatic polyhydric alcohol of ethylene glycol, propylene glycol, tetramethylene glycol, neopentyl glycol, hexylene glycol, polyethylene glycol or polypropylene glycol with epichlorohydrin.

10. The curable epoxy resin composition of claim 7 wherein the polyepoxide of glycidyl ether ester type is a polyglycidyl ether ester obtained by reacting a hydroxycarboxylic acid of p-oxybenzoic acid or β-oxynaphthoic acid with epichlorohydrin.

11. The curable epoxy resin composition of claim 7 wherein the polyepoxide of glycidyl ester type is a polyglycidyl ester obtained by reacting a polycarboxylic acid of phthalic acid, methylphthalic acid, isophthalic acid, terephthalic acid, tetrahydrophthalic acid, hexahydrophthalic acid, endomethylenetetrahydrophthalic acid, endomethylenehexahydrophthalic acid, trimellitic acid, a dimer acid or a polymerized aliphatic acid with epichlorohydrin.

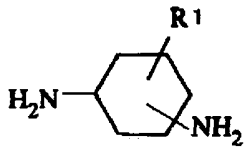
12. The curable epoxy resin composition of claim 7 wherein the polyepoxide of glycidylaminoglycidyl ether type is a glycidylaminoglycidyl ether obtained by reacting aminophenol or an aminoalkylphenol with epichlorohydrin.

13. The curable epoxy resin composition of claim 7 wherein the polyepoxide of glycidylaminoglycidyl ester type is a glycidylaminoglycidyl ester obtained by reacting an aminobenzoic acid with epichlorohydrin.

14. The curable epoxy resin composition of claim 7 wherein the polyepoxide of glycidylamine type is a polyglycidylamine obtained by reacting an amino compound of aniline, toluidine, 2,4,6-tribromoaniline, m-xylylenediamine, 1,2-diaminocyclohexane, 1,3-diaminocyclohexane, 1,4-diaminocyclohexane, 4,4-diaminodiphenyl ether, 4,4-diaminodiphenylmethane, 4,4-diaminodiphenylsulfone, hydantoin, an alkylhydantoin or cyanuric acid with epichlorohydrin.

15. The curable epoxy resin composition of claim 7 wherein the polyepoxide of epoxidized olefin type is an epoxidized polyolefin obtained by epoxidation of an alicyclic polyolefin or an aliphatic polyolefin.

16. A ketimine which is the condensation reaction product of (1) an amine having two or more primary amino groups directly bonded to a cyclohexane ring and represented by the following general formulae



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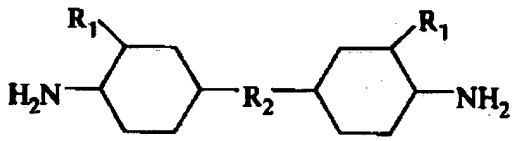
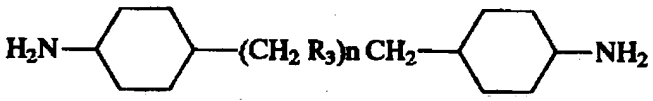
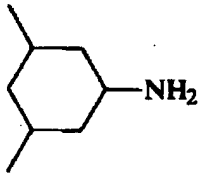


wherein R_1 is a hydrogen atom or a methyl group or an ethyl group, R_2 is a group of -CH_2-, -O- or -SO_2- or



wherein R_3 is



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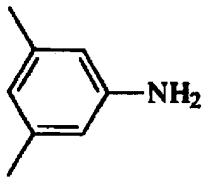

and n is an integer of 1-4 and (2) an aliphatic ketone.

17. The ketimine of Claim 16 in which the amine is 1,2-diaminocyclohexane, 1,3-diaminocyclohexane, 1,4-diaminocyclohexane, 1,2-diamino-4-methylcyclohexane, 1,3-diamino-5-methylcyclohexane, 1,4-diamino-2-methylcyclohexane, 1,2-diamino-4-ethylcyclohexane, 1,3-diamino-5-ethylcyclohexane, 1,4-diamino-2-ethylcyclohexane, bis(4-aminocyclohexyl)methane, bis(4-aminocyclohexyl)ether, bis(4-aminocyclohexyl)-sulfone, bis(3-methyl-4-aminocyclohexyl)methane, bis(3-ethyl-4-aminocyclohexyl)-methane, bis(3-methyl-4-aminocyclohexyl)ether, bis(3-ethyl-4-aminocyclohexyl)ether, bis(3-methyl-4-aminocyclohexyl)sulfone, bis(3-ethyl-4-aminocyclohexyl)sulfone, or an amine obtained by hydrogenation of an oligocondensate of aniline with formaldehyde and the ketone is 2-propanone, 2-butanone, 3-methyl-2-butanone, 3,3-dimethyl-2-butanone, 2-pentanone, 3-pentanone, 2-methyl-3-pentanone, 3-methyl-2-pentanone, 4-methyl-2-pentanone, 4-methyl-3-pentanone, 2,4-dimethyl-3-pentanone, 2-hexanone, 3-

hexanone, 5-methyl-2-hexanone, 2-heptanone, 3-heptanone, 4-heptanone, 2-octanone or 3-octanone.

18. The ketimine of Claim 16 in which the amine is 1,2-diaminocyclohexane, 1,3-diaminocyclohexane, 1,4-diaminocyclohexane, bis(4-aminocyclohexyl)methane, bis(3-methyl-4-aminocyclohexyl)methane or a polyamine obtained by hydrogenation of an oligocondensate of aniline with formaldehyde.

19. The ketimine of Claim 16 in which the ketone is 2-butanone, 3,3-dimethyl-2-butanone, 2-pentanone, 3-pentanone, 2-methyl-3-pentanone, 2,4-dimethyl-3-pentanone or 5-methyl-2-hexanone.

20. The ketimine of Claim 18 in which the ketone is 4-methyl-2-pentanone.